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Water Quality Report

Little Deer Project

Goosenest Ranger District, Klamath National Forest
Siskiyou County, California

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Table of Contents

List of Tables

List of Figures

Executive Summary

Methodology

Overview of Methodology

The effects of the project and its alternatives were analyzed using field visits, Geographic Information System (GIS) reports and modeling. Riparian Reserve widths were determined using the interim widths in the Forest Plan (standard MA10-2, page 4-108). There are no unstable areas in the project area and the risk of landsliding is very low (less than one percent); therefore, effects to landslide risk, including results from the GEO (mass-wasting) cumulative watershed effects model, are not discussed further in this analysis. Cumulative watershed effects models were used to evaluate the effects of soil erosion (Universal Soil Loss Equation – USLE) and to index watershed disturbance (Equivalent Roaded Acres – ERA). The assumptions and caveats of the models can be found in Cumulative Watershed Effects Analysis: Quantitative Models for Surface Erosion, Mass-wasting, and ERA/TOC (USDA Forest Service 2004). Model results fall on a continuum. The models are indexed using a "risk ratio." The threshold of concern for the risk ratio for both models is 1.0. The threshold of concern does not represent the exact point at which adverse cumulative effects will occur. Rather it serves as a "yellow flag" indicating increasing susceptibility for adverse effects to beneficial uses in a watershed.

Analysis Indicators

The analysis indicators were developed to illustrate compliance with law, policy and regulation. These include desired condition and limitations from the Forest Plan, as well as regulations and requirements related to the Clean Water Act.

Likelihood of Meeting Desired Condition for Riparian Reserves

The Forest Plan and the Aquatic Conservation Strategy Objectives outline the desired conditions for the Riparian Reserve function and will be analyzed using a combination of metrics. Very likely to meet desired conditions means there is a greater than 80 percent probability. Likely to meet desired conditions is between 60 and 80 percent. The likelihood of meeting desired condition is probable if between 30 and 60 percent. It is unlikely if it is between 10 to30 percent and very unlikely if less than 10 percent.

- Changes to channel condition/geomorphology is effected by the presence of large wood, rocks and live vegetation that stabilizes banks and minimizes the introduction of fine sediment. The analysis will include acres of activities in the Riparian Reserve and the potential for direct or indirect effects to channel condition from project activities.
- Changes to Riparian Reserve vegetation will be analyzed by the likelihood of re-vegetation of the Riparian Reserve and the type of vegetation expected.
    - Changes to spatial and temporal connectivity within and between watersheds will be analyzed by the estimating the potential for coarse woody debris recruitment and the estimated rate of recovery of large trees and canopy cover in Riparian Reserves.
    - Changes in peak flow will be analyzed using the ERA model and Grant et al. (2008) to estimate the magnitude of change.

Risk to Beneficial Uses

The Total Maximum Daily Loads (TMDLs) for the Shasta River and Klamath River as well as compliance with the waiver for timber harvest (North Coast Region Water Quality Control Board (Water Board 2010)) address water quality requirements. The following metrics were developed to determine effects to beneficial uses and Clean Water Act compliance. A very low risk is where beneficial uses are not likely to be impacted at all by the actions or are likely to be enhanced. A low risk is when beneficial uses are not likely to be measurably affected. For a moderate risk there is likely to be a short-term nuisance impact at the site scale but will recover in less than five years. For a high risk there is likely to be short-term nuisance impacts at a watershed scale but will recovery in less than five years. Finally, a very high risk is when there is likely to be an adverse effect to beneficial uses at any temporal or spatial scale.

- Stream temperature is often used as an analysis indicator of risk to water quality. However, in the Little Deer project area, the only stream is First Creek. The beneficial uses supported by First Creek are not temperature-dependent nor does the temperature of the water in First Creek impact beneficial uses in any tributaries of the Klamath River. Therefore, effects on stream temperature will not be analyzed further for the Little Deer project.
    - Changes to sediment regime and effects to beneficial uses will be analyzed using the USLE model.

Spatial and Temporal Context

The spatial scale for water quality is bound by six 7th field drainages that intersect the project area; these are Upper First Creek, Penoyar Creek, Lower First Creek, Horsethief Creek, Grass Lake Northeast, and Grass Lake South and are chosen because the cumulative watershed effects models are calibrated to this scale and it is the smallest unit where water quality effects can reasonably be measured. The scale for analyzing effects to the Riparian Reserve function is bound by the area proposed for treatment and the channel reaches immediately downstream of the treatment area. This is essentially the reach scale which is the scale at which the Riparian Reserve desired conditions are described.

The temporal scale is considered short-term for effects lasting less than five years or long-term where they persist for five years or more. The split between short-term and long-term is based on the recovery rates predicted in the cumulative effects models.

Affected Environment

There are a constructed stock pond and a groundwater well in the project area. The stock pond is a small shallow hole dug to provide seasonal water for livestock. The groundwater well, Murphy Well, is an open, shallow well that is defined by culvert-like casings. There is no evidence of surface water associated with the well. The only stream-related Riparian Reserve in the project area is along First Creek, an intermittent creek that flows in the early spring. The channel is well defined and about 10 feet across in the northern portion of the project area. Toward Highway 97, the channel becomes a swale with little evidence of annual scour. The creek runs in a ditch next to Highway 97, crosses the highway via a culvert and ends about two miles southwest of the highway in a vernal pool outside the project boundary.

The Little Deer wildfire this past summer shaped the existing condition of the watersheds and the Riparian Reserves. Upper First Creek, Horsethief Creek, and Grass Lake Northeast 7th field watersheds include less than 10 percent of the watersheds' burned areas. Eighteen and seventeen percent of the Grass Lake South and Penoyar 7th field watersheds burned respectively. Lower First Creek was the most affected by the fire with 47 percent of the watershed being burned, much of it with moderate to high soil burn severity. Soil burn severity is used in water quality analysis, as opposed to vegetation burn severity, because soil burn severity is intended to be used in the watershed response to a fire.

Likelihood of Meeting Desired Conditions for Riparian Reserves

Channel Geomorphology

First Creek's channel shows evidence of annual scour through the project area. The channel is rocky with banks that are steep and undercut in places but there is no evidence of incision or entrenchment. The vegetation along the channel was removed by the Little Deer fire, leaving First Creek not entirely meeting desired condition as defined by the Forest Plan. The grasses and shrubs have started to re-sprout but the most of the trees in the Riparian Reserve are fire-killed. There is very little woody material in the Riparian Reserve and there was nothing that met the Forest Plan requirements for coarse woody debris observed during field reconnaissance.

Riparian Reserve Vegetation

Pre-fire, the Riparian Reserve in First Creek was a plantation. The trees were primarily ponderosa pine less than 16 inches in diameter at breast height with fairly uniform spacing. Most of these trees are now fire-killed.

Connectivity

Connectivity for terrestrial and semi-aquatic species was limited before the Little Deer fire and is even more limited after the fire. The fire killed most of the planation conifers in the Riparian Reserve. These trees were primarily less than 16 inches in diameter as noted above. They were short and did not meet the Forest Plan recommendation for coarse woody debris of 20 inches in diameter and 40 cubic feet in volume (standard 6-16, page 4-24). Post-fire, most burned trees do not meet this coarse woody debris recommendation.

Peak Flow

Peak flows are expected to increase by as much as 130 percent over pre-fire conditions for the winter of 2014/2015. Then the peak flows will increase by between 10.5 percent and 14 percent after the first winter and remain at this level for about the next 10 years.

Risk to Beneficial Uses

All tributaries to the Klamath River are listed under section 303(d) of the Clean Water Act for stream temperature impairment (California State Water Quality Control Plan (Basin Plan 2010)); this means that beneficial uses are not being met in the Klamath River and its tributaries. The Little Deer project area has one stream that has limited hydrological connectivity with higher order streams (see description above) in the Klamath River basin. The stream only flows during the snowmelt season and does not have any fish or shellfish habitat. Therefore, effects to beneficial uses due to conditions in the project area are limited to agriculture and wildlife habitat.

The amount of soil loss and sediment delivery to First Creek is higher than previously found due to the Little Deer fire. The delivery of sediment to the stream is between 75 and 112 cubic yards per year based on results of the USLE model. The risk ratios for Upper and Lower First Creek 7th field watersheds are over the threshold of concern. The amount of sediment delivery may cause a nuisance effect to beneficial uses. This will include additional sediment delivered to diversion ditches used for agricultural purposes downstream of the fire and turbid water delivered to the vernal pool at the end of the creek.

Environmental Consequences

Alternative 1

Direct Effects and Indirect Effects

Likelihood of Meeting Desired Conditions for Riparian Reserves

Channel Geomorphology

The dead and dying trees in the Riparian Reserve will begin to fall over the next 5 years and contribute to the woody material in the Riparian Reserve and the stream channel of First Creek. However, in general, the trees are not large enough to meet the Forest Plan definition for coarse woody debris. Despite that, the wood will serve to capture sediment, slow stream flows and stabilize banks. Next spring, the banks will be susceptible to undercutting due to increased runoff and reduction of stabilization from roots from grasses and shrubs. Some of the grasses and shrubs will recover over the summer of 2015 and they will help to stabilize the banks of First Creek similar to pre-fire conditions until the conifer roots begin to decay (after about 10 to 15 years). After that, the banks will be susceptible to erosion and instability until conifers regenerate in the Riparian Reserve.

Riparian Reserve Vegetation

The conifers will be slow to regenerate because the moderate and high severity fire left a lack of seed source in the Riparian Reserve (as in the rest of the project area as discussed in the Vegetation, Range and Botany sections). The potential to recruit large wood over the long-term will be reduced substantially after 5 years as the fire-killed trees fall.

Connectivity

The fire-killed trees that fall will be woody material in the stream but the likelihood of long-term conifer recruitment under natural recovery is low due to the lack of seed crop and competition with shrubs. This will limit connectivity within and between watersheds until large conifers populate the Riparian Reserve and coarse woody debris is available in the channel.

Peak Flow

The peak flows will be elevated for about 10 years after the fire. After that, the peak flows will recover to at least pre-fire conditions in about 20 years. Under pre-fire conditions, the peak flows are increased by less than 10 percent which is the detection level of the peak flow model used in this analysis.

Risk to Beneficial Uses

The amount of soil loss and sediment delivery to First Creek will continue to be elevated as described in the affected environment and risk ratios for Upper and Lower First Creek will continue to be over the threshold of concern. The amount of sediment delivery may continue to cause a nuisance effect to beneficial uses in the short-term as described in the affected environment section.

Cumulative Effects

The ongoing and reasonable foreseeable future actions in the 7th field watersheds analyzed that are considered in the assessing the cumulative effects to water are First Creek Forest Health Management project, Erickson Vegetation, Fuels, and Roads Management project, Pomeroy project, Horsethief Grazing Allotment project and fire salvage on private lands (as described in appendix C). The effects of past actions and events, including the Little Deer fire, are represented by the affected environment.

Likelihood of Meeting Desired Conditions for Riparian Reserve

The ongoing and reasonable foreseeable future actions do not intersect the Riparian Reserve or Streamside Management Zone (for private lands) of First Creek directly. So the cumulative effects for the channel geomorphology, Riparian Reserve vegetation, and connectivity include the direct and indirect effects of alternative 1 added to the past and current situation as represented by the affected environment.

The channel geomorphology will be unstable and susceptible to high flows over the long term as the tree roots begin to decay and are not replaced by large trees in the Riparian Reserve. The Riparian Reserve vegetation will comprise mainly of shrubs and grasses for the long term. The establishment of large trees in the Riparian Reserve will be slow and alternative 1 does nothing to improve the recruitment of trees in the Riparian Reserve over natural recovery. There is currently little woody material to promote connectivity in the Riparian Reserve and there was not material observed in the Riparian Reserve that met the definition of coarse woody debris in the Forest Plan as noted above. Since alternative 1 does nothing to improve the recruitment of large trees for connectivity and future coarse woody debris in the Riparian Reserve over natural recovery, when added to the effects of the affected environment, the peak flows will continue to increase by between 11 percent and 13 percent for the next 10 years.

Adding the effects of alternative 1 to the affected environment, the cumulative effects on Riparian Reserve function result in slow recovery of large trees; this will result in risk to the channel geomorphology due to bank instability and peak flow increases in the short term until conifer vegetation recovers. There will be lack of coarse woody debris recruitment in the long term and connectivity will be reduced.

Risk to Beneficial Uses

Adding the effects of alternative 1 to the affected environment, the cumulative effect to water quality at the 7th field watershed scale (risk ratio for the USLE model) is increased by less than 0.01 over existing conditions. The future foreseeable actions do not add much to the sediment delivery in the 7th field when compared to the effects from the fire. Cumulatively, Upper and Lower First Creek 7th field watersheds are over the threshold of concern and there will be a nuisance impact to beneficial uses including sediment impacting agriculture infrastructure and

turbidity. These impacts are a short-term nuisance effect to the sediment regime at the watershed scale.

Alternative 2

Direct Effects and Indirect Effects

Alternative 2 includes dead tree removal in about 17 acres of Riparian Reserves along First Creek. Heavy equipment is not permitted within 30 feet of the bank of First Creek, and the edge of Murphy Well and the constructed stock pond but will be used in the outer 120 feet of the Riparian Reserves (see project design features on table 2-1 of chapter 2). Non-hazard fire-killed trees greater than 20 inches in diameter in the Riparian Reserve adjacent to First Creek will be retained as snags and future coarse woody debris. There will be 60 acres of conifer reforestation in Riparian Reserves in alternative 2.

Likelihood of Meeting Desired Condition for Riparian Reserve

Channel Geomorphology

There will be direct impacts to the channel at designated stream crossing if the intermittent channel is crossed with skidding equipment. There are project design features that limit when and where the channel can be crossed (table 2-1 of chapter 2). These limitations along with the rocky character of the stream bed will minimize impacts to the channel geomorphology. The affected areas are likely to be recovered in less than two years.

The availability of woody debris in the Riparian Reserve will be reduced but not eliminated due to dead tree removal. Limitations on removal of trees greater than 20 inches in diameter at breast height will limit impacts to coarse woody debris Recruitment. Conifer reforestation will increase the speed of reforestation in the Riparian Reserves (see the Vegetation section for additional information on vegetation recovery). This will increase the speed of root-strength recovery to promote bank stability and the recruitment of trees that meet the criteria for coarse woody debris in the long term.

Riparian Vegetation

The planting of conifers in the Riparian Reserve adjacent to First Creek will to decrease the time it will take to re-establish a conifer forest in the Riparian Reserve (see Vegetation report). In 20 years, it is expected that the conifers planted will be well established.

Connectivity

The effect of delayed establishment of conifers will be a delay in the recovery of connectivity in the Riparian Reserves. While it will take more than 50 years to establish a forest with closed canopy and trees greater than 20 inches in diameter, the recovery that will occur will improve connectivity.

Peak Flow

The ERA will be increased by as much as 42 acres and as little as three acres of equivalent roaded acres. This translates into about an eight percent increase in peak flows over the current situation as displayed in the affected environment section. The peak flow will stay about eight percent higher than what will occur if no action is taken for about 10 years; then, the area will

begin to recover. The increase in peak flows is not measurable and won't impact the function of the Riparian Reserve in the short or long term.

The existing stream channel geomorphology will remain intact. There will be an increase in the speed of reforestation in the Riparian Reserve which will create conditions where coarse woody debris will be recruited, and connectivity will be improved via increased shade and downed wood. Peak flows will be elevated but not to the point where the riparian function will be compromised or what can be accommodated by existing infrastructure. Alternative 2 is likely to meet desired condition of riparian function for all measures.

Risk to Beneficial Uses

Alternative 2 will contribute between 0.03 and 0.44 cubic yards of sediment to the watersheds per year, for the first 4 years post implementation (see appendix B of the Water Quality resource report, table 8). To put this into perspective a pickup truck bed can hold a cubic yard of material. So the project will produce less than a pickup truck load of sediment from soil erosion. This may cause a small amount of aggregation in any diversion ditches carrying water from the project area and it will create a small amount of turbidity in winter run off stream flows. The risk to beneficial uses is moderate.

Cumulative Effects

Adding the effects of alternative 2 to those represented by the affected environment, the cumulative effect to water quality at the 7th field watershed scale (risk ratio for the USLE model) is increased by less than 0.02 over existing conditions. Cumulatively, Upper and Lower First Creek 7th field watersheds will be over the threshold of concern and there will be a nuisance impact to beneficial uses including sediment impacting agriculture infrastructure and turbidity. These impacts are a short-term nuisance effect to the sediment regime at the watershed scale. The effect of reasonable foreseeable future actions is as discussed for alternative 1. The cumulative risk to beneficial uses from adding the effects of alternative 2 to those of ongoing and reasonable foreseeable future actions is moderate.

Alternative 3

Direct Effects and Indirect Effects

Likelihood of Meeting Desired Condition for Riparian Reserve

The direct and indirect effects of alternative 3 on *channel geomorphology, riparian vegetation and connectivity* are the same as for alterative 1. The effects to peak flow are the same as for alternative 2.

Risk to Beneficial Uses

The effect of alternative 3 on sediment delivery to streams is similar to alternative 2. The difference is the sediment delivery of alternative 3 as estimated by the USLE model is 0.01 cubic yard less than for Upper and Lower First Creek in alternative 2. The overall effect to beneficial uses is the same as for alternative 2.

Cumulative Effects

The cumulative effects for channel geomorphology, riparian vegetation, and connectivity are the same as for alternative 1. The cumulative effects on peak flow and water quality are the same as for alternative 2.

Comparison of Effects

Effects of alternatives on water quality are compared above under the effects of each alternative and in table 2-3 in chapter 2 of this EA.

Compliance with law, regulation, policy, and the Forest Plan

The project complies with the Basin Plan, The Porter Cologne Act, the Total Maximum Daily Load and the Clean Water Act by complying with the conditions of the waiver of timber harvest (Water Board 2010). The project also complies with the Forest Plan standards (see Forest Plan Checklist on the project website).

Water Quality Report

Introduction

The purpose of this water quality report is to 1) describe the affected environment and desired conditions relative to Riparian Reserves and water quality, 2) analyze and contrast the alternatives direct, indirect and cumulative effects to water quality, and 3) address compliance with water quality law, regulation, policy and Forest Plan Standards and Guidelines.

Methodology

Detailed Methodology

The effects of the project and its alternatives were analyzed through field visits, GIS reports and modeling. The analysis of potential water quality effects of proposed activities began with field-validation of existing hydrologic information. Field reconnaissance consisted of evaluating existing data which included; reviewing the National Hydrography Dataset (NHD) and field checking every hydrologic Riparian Reserve with in the project area.. The Forest Plan distinguishes between fish-bearing, permanently flowing non-fish bearing, and seasonally flowing or intermittent stream types. The Forest Plan also includes constructed ponds as hydrologic Riparian Reserves (Forest Plan Standards and Guidelines pg. 4-108).

This project uses the interim Riparian Reserve widths defined in the Forest Plan (Standard and Guideline 10-2). Fish-bearing streams have Riparian Reserve widths of 300 feet or two site trees whichever is greater. Permanently flowing non-fish bearing streams have Riparian Reserve widths of 150 feet or one site tree whichever is greater. Seasonally flowing or intermittent streams have a Riparian Reserve width of the height of one site potential tree or 100 feet whichever is greater. Constructed ponds have a width of the edge of riparian vegetation or soil saturation, 150 feet or one site tree height whichever is greater.

Unstable areas are also Riparian Reserves. There are no unstable areas in the Little Deer Project area and the landscape has an inherently very low risk (<1%) of landsliding due to the extent of flat land and the competent nature of the rock in the area. Unstable lands and landsliding will not be analyzed further in this analysis.

There are three elements to the cumulative watershed effects model used by the Forest: surface erosion and sediment delivery (USLE); sediment delivery from mass wasting/landsliding (GEO); and the disturbance index using Equivalent Roaded Acres (ERA). The assumptions and caveats of the model can be found in *Cumulative Watershed Effects Analysis: Quantitative Models for Surface Erosion, Mass-wasting and ERA/TOC* (USDA, US Forest Service 2004). A summary of the models and how to interpret the results can be found in *Cumulative Watershed Effects Modeling: The Abridged Version* (Bell, 2012). The GEO model is based on landslide processes, rates and influences on the west-side of the Forest. This model does not represent mass-wasting processes in the Little Deer project area and will not be used in the effects analysis of this report.

Model results fall on a continuum. As disturbances increase (and recover) over time and space, at some point, the risk of initiating or contributing to existing adverse cumulative watershed impacts becomes a cause for concern. These model-specific levels are called “risk ratios”. The

Threshold or Concern (TOC) for the risk ratios is 1.0. Ecologically, a transition exists from lower to higher risk of adverse effects to beneficial uses – from insignificant to potentially significant. From a management perspective, TOC is intended to represent the center of that transition zone. The TOC does not represent the exact point at which adverse cumulative watershed effects will occur. Rather, they serve as "yellow flag" indicators of increasing susceptibility for significant adverse effects occurring within a watershed.

Analysis Indicators

Analysis indicators were developed to illustrate compliance with law, policy and regulation. These include the desired conditions and limitations from the Forest Plan as well as regulations and requirements related to the Clean Water Act.

The desired condition described in the Forest Plan for Riparian Reserves (pg. 4-106:107) include a multi-layer canopy in forested Riparian Reserves where the soils are deep enough to support it. Large woody material, rocks and live vegetation are present along streams to help provide stability to the riparian areas and complexity to the semi-aquatic and aquatic habitats. A mixture of brush, grass, forbs and sedges provide for bank stability and integrity. The riparian plant community includes all ages and sizes of vegetation. The riparian vegetation is diverse and dense enough to stabilize banks and hillslopes, while providing areas that catch sediment and contributes to large wood in the Riparian Reserves. Stream flows are adequate to protect semi-aquatic and aquatic habitat. Water quality standards are met or exceeded. Fine sediment from management activities does not adversely affect stream channels. Infrastructure (bridges, culverts, and stream crossings) should be able to accommodate peak flows.

Projects must meet or not prevent the attainment of the Aquatic Conservation Strategy Objectives (Forest Plan, pg. 4-6). There are nine objectives which include watershed complexity, sediment and flow regimes, connectivity, channel integrity, water quality, floodplain inundation, species composition in Riparian Reserves and habitat.

The Porter-Cologne Water Quality Control Act (Section 13050(f)) calls for the assignment of "beneficial uses" of water for each hydrologic units and the protection of beneficial uses against water quality degradation. The assignment and enforcement of water quality standards serves to meet the Clean Water Act requirements (Sections 101(a)(2) and 303(c). beneficial uses are assigned in the Water Quality Control Plan for the North Coast Region (Basin Plan) (NCWQCB, 2011, table 2-1). The Clean Water Act Section 303(d) requires states to identify bodies of water that do not meet the water quality standards and are not supporting beneficial uses. Waters listed as impaired will have an additional layer of regulation in the form of a Total Maximum Daily Load (TMDL) which is included in the Basin Plan. There are TMDL's in place for the Shasta River and the Klamath River. The Shasta River is listed impaired for dissolved oxygen and temperature which exceed the thresholds for basin plan objectives and salmonids respectively. The Klamath River is listed for low dissolved oxygen, high water temperatures, and high nutrient loads. The Little Deer project is not likely to create any new nutrient loads or contribute to dissolved oxygen so they will not be analyzed further in this report. This report will disclose the effects to temperature and sediment as a result of the project. The TMDL connects excessive sediment loads (anthropogenic) as a source of increased temperature in the Klamath River Basin. The Basin Plan's objective for sediment is that sediment load won't adversely affect beneficial uses (Basin Plan, pg. 3-3.00).

The Waiver of Waste Discharge Related to Certain Federal Land Management Activities on National Forest System Lands in the North Coast Region (the Waiver) (NCWQCB, 2010) was developed to meet the requirements of the TMDLs. Compliance with the Waiver conditions constitutes compliance with sediment and temperature TMDL implementation plans (NCWQCB, 2010, no. 16). The conditions include disclosing activities in Riparian Reserves, on-the-ground prescriptions to meet Best Management Practices (project design features), discussion of direct, indirect and cumulative effects of activities, and legacy sediment source inventories.

Legacy Sediment Sources were identified using the Forest Road Sediment Source Inventory (RSSI) and field reconnaissance. The inventory, prioritization and scheduling for mitigation of Legacy Sediment Sources is required to be compliant with the North Coast Regional Water Quality Control Board (Water Board) Waiver of Discharge requirements, Category B (California Regional Water Quality Control Board, North Coast Region, 2010). Sites were considered legacy sediment sources if they 1) are or have the potential to contribute sediment to a state regulated waterway, 2) are caused or exacerbated by land management activities, and 3) are reasonably mitigatable. Legacy sediment source inventory results can be found in appendix D of this report.

There are two general analysis indicators for the Little Deer project: 1) Function of Riparian Reserve, and 2) Risk to Water Quality. The methods of analysis are described below.

Likelihood of meeting desired conditions for Riparian Reserves.

- The Forest Plan and the Aquatic Conservation Strategy Objectives outline the desired conditions for the Riparian Reserve Function and will be analyzed using a combination of metrics. Very likely to meet desired conditions means there is a greater than 80% probability. Likely to meet desired conditions is between 60 and 80 percent. The likelihood of meeting desired condition is probable if between 30 and 60 percent. It is unlikely if it is between 10-30% and very unlikely if less than 10%.
    - Changes to channel condition/geomorphology is effected by the presence of woody material (including coarse woody debris), rocks and live vegetation that stabilizes banks and minimizes the introduction of fine sediment. The analysis will include acres of activities in the Riparian Reserve and the potential for direct or indirect effects to channel condition from project activities.
    - Changes to Riparian Reserve vegetation will be analyzed by the likelihood of re-vegetation of the Riparian Reserve and the type of vegetation expected.
    - Changes to spatial and temporal connectivity within and between watersheds will be analyzed by the estimating the potential for CWD recruitment and the estimated rate of recovery of large trees and canopy cover in Riparian Reserves.
    - Changes in peak flow will be analyzed using the ERA model and Grant et al. (2008) to estimate the magnitude of change. The methods includes converting the ERA results into equivalent clear cut acres and using figure 10 from Grant et al (2008) to determine the predicted changes to peak flow. The ERA is divided by the total watershed acres to get percent watershed. The percent watershed ERA is converted to Equivalent Clearcut Acres by multiplying the percent ERA by 4. Using Figure 10 in Grant et al. (2008) the percent increase in peak flow can be estimated.

Risk to beneficial uses

- The TMDLs for the Shasta River and Klamath River as well as compliance with the Waiver address water quality requirements. The following metrics were developed to determine effects to beneficial uses and Clean Water Act compliance. Risk level is defined for this assessment below:
    - Very low risk: beneficial uses are not likely to be impacted at all by the actions or are likely to be enhanced.
    - Low risk: beneficial uses are not likely to be measurably effected.
    - Moderate risk: There is likely to be a short-term nuisance impact at the site scale but will recover in less than 5 years.
    - High risk: There is likely to be short-term nuisance impacts at a watershed scale but will recovery in less than 5 years.
    - Very high risk: There is likely to be an adverse effect to beneficial uses at any temporal or spatial scale.
- Change to stream temperature is a concern in both the Shasta River and Klamath River basins. It is measured using potential versus existing shade on the stream channel. The stream in the project area (First Creek), which is in the Klamath River Basin, is an intermittent stream that does not typically flow into the month of July and therefore is not considered a late-flowing intermittent stream. The stream channel stops at a vernal pool near highway 97 and is not hydrologically connected to any other stream in the watershed. The stream does not provide a cold water source to the Klamath River or any other tributary nor is it a cold water refugia. The beneficial uses supported by First Creek are not temperature dependent nor does the temperature of the water in First Creek impact beneficial uses in any tributaries of the Klamath River. So effects on stream temperature will not be analyzed further for the Little Deer project.
    - Changes to sediment regime and effects to beneficial uses will be analyzed using the USLE model.

Spatial and Temporal Bounding of Analysis Area

The spatial scale for water quality is bound by six 7th field drainages that intersect the project area; these are Upper First Creek (18010205010301), Penoyar Creek (18010105010302), Lower First Creek (18010205010303), Horsethief Creek (18010205010304), Grass Lake Northeast (18010207040102), and Grass Lake South (18010207040103) because the cumulative watershed effects models are calibrated to this scale and it is the smallest unit where water quality effects could reasonably be measured. The scale for analyzing effects to the Riparian Reserve function is bound by the area proposed for treatment and the channel reaches immediately downstream of the treatment area. This is essentially the reach scale, which is the scale the Riparian Reserve desired conditions are described at.

The temporal scale is considered short-term for effects lasting less than 5 years or long-term where they persist for 5 years or more. The split between short-term and long-term is based on the recovery rates predicted in the cumulative effects models.

Affected Environment

The Little Deer project area is in the Cascade Range which is made up primarily of geologically young basaltic and andesitic volcanoes and lava flows. These lava flows were then faulted by Basin and Range extensional tectonics. This geologic condition creates closed basins where stream channels flow into a basin but do not flow out. The bedrock is extremely porous due to the nature of the basalt/andesite, lava tubes and the fault zones. If water flows on the surface it will flow into a closed basin and infiltrate into the groundwater.

The only stream related Riparian Reserve in project area is along First Creek, an intermittent creek that flows in the early spring (Figure 3). The channel is well defined and about 10 feet across in the northern portion of the project area. Toward Highway 97 the channel becomes a swale with spatially intermittent evidence of annual scour. The creek runs in a ditch next to Highway 97 and crosses the highway via a culvert and ends about two miles southwest of the highway in a vernal pool. There is a stream crossing on First Creek on Forest Service road 45N48Y. The crossing is at the top of the creek channel and has an 18 inch culvert with a small road fill (<15 cubic yards). There is a dip at the crossing.

There are is a constructed stock pond (Figure 2), just off of 45N48Y in Section 3, and a groundwater well. The stock pond is a small shallow whole dug to provide seasonal water for livestock. The area is bermed and riparian vegetation was re-sprouting between the water and the berm at the time of field visit in September. The groundwater well, Murphy Well (Figure 1), is an open, shallow well that is defined by culvert-like casings. There is no evidence of surface water associated with the well.

The crossing needs some rock on the fill to which is planned for in the Burned Area Emergency Response road work being completed this fall. There is a rock-armored, low-water stream crossing on the creek on the temporary road on existing road bed just past Murphy Well. The temporary road on existing road bed that runs adjacent to the stream channel in Section 9 above the channel and the channel is defined well enough that there is no diversion potential. First Creek is a first to second order stream and is not a tributary to any 3rd to 5th order streams.

Figure 1: Example of the channel geomorphology of First Creek in project area.

Figure 2: Murphy Well taken just after the fire.

Figure 3: Stock pond off of 45N48Y.

The Little Deer wildfire this past summer has shaped the existing condition of the watersheds and the Riparian Reserves. Upper First Creek, Horsetheif Creek, and Grass Lake Northeast have less than 10% of the watersheds burn. Eighteen and seventeen percent of the Grass Lake South and Penoyar watersheds burned respectively. Lower First Creek was the most affected by the fire with 47% of the watershed being burned, much of it with moderate to high soil burn severity (Table 1). Soil burn severity is used in water quality analysis, as opposed to vegetation burn severity, because soil burn severity is intended to be used in watershed response to a fire.

Soil Burn Severity is an index used to predict watershed responses after a fire. It is related to vegetation morality, but includes aspects of the soil structure and the soils permeability to water (hydrophobicity). Very low and low Soil Burn Severity areas will have live vegetation remaining, the soil structure remains relatively unaffected by the fire and there is little or no increase in hydrophobicity. A moderate Soil Burn Severity will have areas with dead trees with needle still on the branches, a moderate amount of the soil structure destroyed and an increase in hydrophobicity. A high Soil Burn Severity has dead trees with no fines on the branches, soil

structure destroyed and high hydrophobicity. The moderate and high Soil Burn Severities are areas where an increased watershed response such as increased soil loss and peak flows are likely to occur.

Table 1: Soil Burn Severity by watershed as a result of the Little Deer Fire.

HUC Name	Very Low Burn Severity (acres)	Low Burn Severity (acres)	Moderate Burn Severity (acres)	High Burn Severity (acres)	Total Watershed Burned (acres)	Total Watershed Area (acres)	Percent Watershed Burned
Upper First Creek	22	32	37	2	94	6,965	1%
Penoyar	248	215	814	145	1323	7,946	17%
Lower First Creek	132	291	934	307	1663	3,593	46%
Horsethief Creek	143	210	376	61	789	8,677	9%
Grass Lake Northeast	33	57	49	5	144	5,500	3%
Grass Lake South	210	217	821	233	1480	8,305	18%

Function of Riparian Reserves

Channel Geomorphology

Currently, the channel geomorphology is not fully meeting channel geomorphology desired condition. Immediately after the Little Deer fire the grasses and shrubs in the Riparian Reserve, including those aiding in bank stability were absent. Since the fire, grasses and shrubs have started to re-sprout. Much of the channel is lined with rock levies (Figure 1) and has a rocky bed. The banks are steep and undercut in places but no sign of incision or entrenchment. There is very little coarse woody debris in the Riparian Reserve. There is little evidence that there was much large wood in the Riparian Reserve pre-fire and what little there was has been removed (burned) by the fire.

Riparian Vegetation

The current condition of the riparian vegetation does not fully meet desired conditions as described in the Forest Plan. The Riparian Reserve of First Creek was in a plantation. The trees are primarily ponderosa pine with diameters of less than 16 inches in diameter at breast height with fairly uniform spacing. The Little Deer fire burned with moderate and high soil severity in the Riparian Reserve. So many of the plantation conifers are dead and the shrubs and grasses were burned off. There is evidence of shrubs and grasses covering the ground in the Riparian Reserve. Currently, there are shrubs and grasses re-sprouting in and near the channel. There is needle cast in the Riparian Reserve which is providing soil cover in the interim.

Connectivity

Connectivity for terrestrial and semi-aquatic species was limited before the Little Deer fire and is even more limited after the fire. The fire killed most of the planation conifers in the Riparian Reserve. These trees are primarily less than 16 inches as noted above. they are short and did not meet the Forest Plan recommendation for coarse woody debris of 20 inches in diameter and 40

cubic feet in volume (pg. 4-24). Post-fire, most burned trees do not meet the coarse woody debris recommendation made in the Forest Plan.

Peak Flow

Run off modeling completed during the Burned Area Emergency Response assessment shows that the expected increase in storm runoff for First Creek by 131% for a 2 year storm event, 50% for a 5 year storm event, and 62% for a 25 year storm event for the first winter after the fire (USFS 2014). These values are for the first winter after the fire. The ERA model outputs for the existing condition (Table 7 in appendix B) represent the effects of the fire on peak flows after the first year until about 10 years post-fire. The risk ratios do stay under the threshold of concern but are raised by the disturbance of the wildfire. The ERA was increased in Upper and Lower First Creek by 171 and 196 acres respectively by the Little Deer Fire. Penoyar's ERA was increased by 142 acres. The ERA in the other watersheds was increased by between 8 acres and 71 acres. The estimated increase in peak flow post-fire is summarized in Table 2.

Table 2: Affected Environment Percent ERA, Percent Equivalent Clearcut area and expected increase in peak flow using Grant et at (2008).

Peak Flow (grant et al)	ERA (% of watershed)	Equivalent Clearcut Area (% of watershed)	Post-fire Increase in Peak Flow (%)
Upper First Creek	5.32%	21.29%	11%
Penoyar	7.67%	30.67%	12%
Lower First Creek	7.95%	31.81%	12%
Horsethief Creek	10.35%	41.39%	13%
Grass Lake Northeast	9.81%	39.24%	13%
Grass Lake South	6.82%	27.29%	12%

Beneficial uses

The Existing beneficial uses for the Bray Hydrologic Unit are municipal water supply (MUN), agriculture (AG), recreation (REC1 and REC2), commercial (COM), wildlife habitat (WILD), Threatened/Endangered species (RARE), migration of aquatic organisms (MIG), shellfish harvesting (SHELL), spawning habitat (SPWN). Hydroelectric power (POW) and aquiculture (AQUA) are potential beneficial uses in the hydrologic unit.

All tributaries to the Klamath River are 303(d) clean water act (CWA) listed for stream temperature impairment (California State Water Quality Control Board (CSWQCB 2010); which means that beneficial uses are not being met in the Klamath River and its tributaries. The Little Deer project area has one Riparian Reserve that has limited hydrologically connectivity with higher order streams (see description above) in the Klamath River basin. The stream only flows during the snowmelt season and does not have any fish or shellfish habitat. So, effects to beneficial uses due to conditions in the project area are limited to agriculture and wildlife habitat.

The amount of soil loss and sediment delivery to First Creek is elevated due to the Little Deer fire. The USLE model results are in Table 8 in appendix B and summarized in Table 3. The risk ratio for Upper and Lower First Creek are over the threshold of concern. The amount of sediment delivery may cause a nuisance effect to Beneficial Use. This will include additional sediment delivered to diversion ditches used for agricultural purposes downstream of the fire. Turbid water will be delivered to the vernal pool at the end of the creek.

There is a non-system road within the Riparian Reserve (see Figure 6). The road is relatively flat and showed no signs of water flowing down the roadbed or road sediment being delivered to the stream channel. There is a low water crossing on First Creek just before the Forest Service property boundary. The crossing is well armored and has no potential for diversion of flows onto the road.

Table 3: Summary of USLE model results for affected environment.

7th field Watershed	Sediment Increase related to Little Deer fire (yd^3/year)	Total Sediment (includes background, roads, and fire) (yd^3/year)	Affected Environment risk ratio
Upper First Creek	49	108	1.13
Penoyar	25	112	0.91
Lower First Creek	50	95	1.68
Horsethief Creek	2	75	0.57
Grass Lake Northeast	13	82	0.93
Grass Lake South	1	112	0.76

Environmental Consequences

Alternative 1

Direct Effects and Indirect Effects

Function of Riparian Reserves

Channel Geomorphology

The dead and dying trees in the Riparian Reserve will begin to fall over the next 5 years and contribute to the woody material in the Riparian Reserve and the stream channel of First Creek. However, in general, the trees are not large enough to meet the Forest Plan definition for coarse woody debris. Despite that, the wood will serve to capture sediment, slow stream flows and stabilize banks. Next spring, the banks will be susceptible to undercutting due to increased runoff and reduction of stabilization from roots from grasses and shrubs. The grasses and shrubs should recover over the summer of 2015 and they will work to stabilize the banks of First Creek similar to pre-fire conditions until the conifer roots begin to decay (about 10-15 years out). After that, the banks will be susceptible to erosion and instability until conifers regenerate in the Riparian Reserve.

Riparian Reserve Vegetation

The conifers will be slow to regenerate because the moderate and high severity fire left a lack of seed source in the Riparian Reserve (as in the rest of the project area as discussed in the Vegetation, Range and Botany sections of the EA). The potential to recruit large wood over the long-term will be reduced substantially after 5 years as the fire killed trees fall.

Connectivity

The fire killed trees will have fallen and will be woody material in the stream, but the likelihood of long-term conifer recruitment under natural recovery is low due to the lack of seed crop and

competition with shrubs. This will limit connectivity within and between watersheds until large conifers populate the Riparian Reserve and coarse woody debris is available in the channel.

Peak Flow

The peak flows will be elevated for about 10 years after the fire. After that, the peak flows will recover to at least pre-fire conditions about 20 years. Under pre-fire conditions the peak flows were increased by less than 10%, which is the detection level of peak flow model used in this analysis. The culverts and stream crossings are capable of accommodating this additional flow.

The No Action alternative is unlikely to meet desired condition in the next 50 years for channel geomorphology, riparian vegetation and connectivity. This is due to the slow rate of natural recovery of conifer forest in the Riparian Reserve due to lack of seed source left behind by the Little Deer Fire. It is very likely to meet desired conditions for peak flow.

Water Quality

The amount of soil loss and sediment delivery to First Creek will continue to be elevated as described in the affected environment and risk ratios for Upper and Lower First Creek will continue to be over the Threshold of Concern. The amount of sediment delivery may continue to cause a nuisance effect to beneficial uses in the short-term as described in the affected environment section.

Cumulative Effects

The on-going and reasonable foreseeable actions in the 7th field watersheds analyzed are First Creek Forest Health Management project, Erickson Vegetation, Fuels, and Roads Management project, Pomeroy project, Bray and Horsethief Grazing Allotment project and fire salvage on private lands were considered in the cumulative effects of the analysis indicators (See EA for descriptions). The effects of past actions and events, including the Little Deer fire, are incorporated into the Affected Environment.

Function of Riparian Reserve

The on-going and reasonable foreseeable actions do not intersect the Riparian Reserve or Streamside Management Zone (for private lands) of First Creek directly. So the cumulative effects for the channel geomorphology, Riparian Reserve vegetation, and connectivity include the direct and indirect effects of the alternative 1 added to the past and current situation as represented by the affected environment. The *channel geomorphology* will be compromised over the long-term (10- 50 years) as the tree roots begin to decay and are not replaced by large trees in the Riparian Reserve. The resulting bank instability will put the channel geomorphology at risk from to high flows. The channel geomorphology is not likely to meet desired conditions on the long-term (> 50 years).

The *Riparian Reserve vegetation* will comprise mainly of shrubs and grasses for the long-term. Most of the trees in the Riparian Reserve are fire-killed and there is limited seed source for recruitment of new trees. The re-sprouting shrubs will be competition for new seedlings. The establishment of large trees in the Riparian Reserve will be slow and alternative 1 does nothing to improve the recruitment of trees in the Riparian Reserve over natural recovery.

Connectivity is degraded in the Riparian Reserves in the project area. There is currently little woody material in the Riparian Reserve and there was not material observed in the Riparian

Reserve that met the definition of coarse woody debris in the Forest Plan as noted above. The fire-killed trees in the Riparian Reserve will fall and become woody material, but most are not large enough to meet coarse woody debris requirements. Alternative 1 does nothing to improve the recruitment of large trees for connectivity and future coarse woody debris in the Riparian Reserve over natural recovery.

The future foreseeable actions will affect *peak flows* and will contribute sediment to water bodies in Upper First Creek, Lower First Creek, Grass Lake Northeast, and Grass Lake South (Table 8 in appendix B). There are about 85, 8, 36, and 5 acres of ERA in the Upper First Creek, Lower First Creek, Grass Lake Northeast, and Grass Lake South respectively as a result of the future foreseeable actions. The risk ratios are increased by less than 0.02 for the watersheds over the Affected Environment (Table 7 in appendix B). When added together the cumulative effect of the alternative 1 and the affected environment the peak flows will be increased by between 11% - 13% (Table 4) for the next 10 years.

Table 4: Cumulative Percent ERA, Percent Equivalent Clearcut area and expected increase in peak flow using Grant et at (2008) for No Action.

Peak Flow (grant et al)	ERA (% of watershed)	Equivalent Clearcut Area (% of watershed)	Post-fire Increase in Peak Flow (%)
Upper First Creek	6.5%	26.0%	11%
Penoyar	8.6%	34.4%	12%
Lower First Creek	8.2%	32.8%	12%
Horsethief Creek	10.3%	41.4%	13%
Grass Lake Northeast	10.5%	42.0%	13%
Grass Lake South	6.9%	27.6%	12%

The cumulative effects on Riparian Reserve Function result in slow recovery of large trees which will result in risk to the channel geomorphology due to bank instability and peak flow increases. There will be lack of coarse woody debris recruitment on the long-term and connectivity will be reduced. The natural recovery will occur and alternative 1 does not prevent the attainment of desired conditions. However, the likelihood that the desired conditions will be met in 50 years is unlikely for channel geomorphology, riparian vegetation and connectivity. The cumulative likelihood of meeting desired conditions for peak flow is likely because the existing infrastructure will be able to accommodate the increase in flow.

Risk to beneficial uses

Adding the effects of alternative 1 to the affected environment, the cumulative effect to water quality is analyzed at the 7th field watershed scale. The cumulative risk ratio for the USLE model is increased by less than 0.01 over existing conditions. The future foreseeable actions do not add much to the sediment delivery in the 7th field when compared to the effects from the fire. Cumulatively, Upper and Lower First Creek 7th field watersheds are over the threshold of concern and there will be a nuisance impact to beneficial uses including sediment impacting agriculture infrastructure and turbidity in water used by semi-aquatic and terrestrial animals. These impacts are a short-term nuisance effect to the sediment regime at the watershed scale. The cumulative risk to beneficial uses is moderate.

Alternative 2

Direct and Indirect Effects

Alternative 2 includes dead tree removal in about 17 acres of Riparian Reserves along First Creek. Heavy equipment is not permitted within 30 feet of the bank of First Creek, Murphys Well and the construct stock pond, but will be used in the outer 120 feet of the Riparian Reserves (See project design features in chapter 2 of the EA). Non-hazard fire-killed trees greater than 20 inches in the Riparian Reserve adjacent to First Creek will be retained as snags and future coarse woody debris. There will be 60 acres of conifer reforestation in Riparian Reserves in alternative 2.

Function of Riparian Reserve

Channel Geomorphology

There will be direct impacts to the channel at designated stream crossing if the intermittent channel is crossed with skidding equipment. There are project design features that limit when and where the channel can be crossed (chapter 2 of EA). These limitations along with the rocky character of the stream bed will minimize impacts to the channel geomorphology. The affected areas are likely to be recovered in less than two years.

The trees being removed from the Riparian Reserve are dead or have a 70% probability of dying in the next year. The removal of dead trees in the outer 120 feet of the Riparian Reserve along First Creek will reduce, but not completely eliminate, the availability of woody debris on the short term. However, the restrictions on dead tree removal mentioned above and in chapter 2 of the EA mean that the trees that meet the coarse woody debris characteristics will remain in the Riparian Reserve.

Conifer reforestation will increase the speed of reforestation in the Riparian Reserves. See the Vegetation report for details on vegetation recovery. This will speed up root strength recovery to promote bank stability as well as the recruitment of trees that meet the criteria for coarse woody debris on the long-term.

Riparian Vegetation

Planting conifers in the Riparian Reserve adjacent to First Creek will decrease the time it will take to re-establish a conifer forest in the Riparian Reserve (see Vegetation Report). In 20 years, it is expected that the conifers planted will be well established.

Connectivity

The effect of delayed establishment of conifers will be a delay in the recovery of connectivity in the Riparian Reserves. While it will take more than 50 years to establish a forest with closed canopy and trees greater than 20 inch in diameter at breast height the recovery is still faster than the no action alternative (see Vegetation report).

Peak Flow

The ERA will be increased by as much as 42 acres and as little as 3 acres of equivalent roaded acres (see Table 7 in appendix B). This translates into about an 8% increase in peak flows over the current situation as displayed in the affected environment section. The peak flow will stay about 8% higher than No Action for about 10 years and then the area will begin to recover (Table

5). So the increase in peak flows is not measurably increased and won't impact the function of the Riparian Reserve on the short or long-term.

Table 5: Peak Flow analysis using Grant et al. (2008) for alternative 2.

Watershed Name	Equivalent Clearcut Acres	Percent of Watershed	Estimated increase in Peak Flow from Alt. 2
Upper First Creek	129	2%	8%
Penoyar	145	2%	8%
Lower First Creek	166	5%	8%
Horsethief Creek	11	0.1%	<8% **
Grass Lake Northeast	38	0.7%	<8%**
Grass Lake South	19	0.2%	<8%**

*** 8% is the lowest increase reported in the model provided by Grant et al (2008).*

The existing stream channel geomorphology will remain intact. There will be an increase in the speed of reforestation in the Riparian Reserve which will create conditions where coarse woody debris will be recruited and connectivity will be improved via increased shade and downed wood. Peak flows will be elevated, but not to the point where the riparian function will be compromised or what can be accommodated by existing infrastructure. alternative 2 is likely to meet desired condition of Riparian Function for all measures.

Risk to Water Quality

Alternative 2 will contribute between 0.03 and 0.44 cubic yards of sediment to the watersheds per year, for the first 4 years post implementation (Table 8 in appendix B). To put this into perspective a pickup truck bed can hold a cubic yard of material. So the project will produce less than a pickup truck load of sediment from soil erosion. This may cause a small amount of aggregation in any diversion ditches carrying water from the project area and it will create a small amount of turbidity in winter run off stream flows. The risk to beneficial uses is moderate.

Cumulative Effects

The on-going and reasonable foreseeable actions in the 7th field watersheds analyzed are First Creek Forest Health Management project, Erickson Vegetation, Fuels, and Roads Management project, Pomeroy project, Bray and Horsethief Grazing Allotment project and fire salvage on private lands were considered in the cumulative effects of the analysis indicators (See EA for descriptions). The effects of past actions and events, including the Little Deer fire, are incorporated into the Affected Environment.

Function of Riparian Reserve

The on-going and reasonable foreseeable actions do not intersect the Riparian Reserve or Streamside Management Zone (for private lands) of First Creek directly. So the cumulative effects for the channel geomorphology, Riparian Reserve vegetation, and connectivity include the direct and indirect effects of alternative 2 added to the past and current situation as represented by the affected environment.

Channel Geomorphology

The channel geomorphology will be affected by the decay of conifer roots in the Riparian Reserve which will decrease the bank stability over the next 10-15 years or so. Natural Recovery will continue to occur overprinted by conifer reforestation efforts which will result in the re-establishment of conifer root strength in the next 20 years. Cumulatively there will be a gap between 10 and 20 years where woody material will be scarce and the banks will be susceptible to high flows. However, after 20 years the channel geomorphology is likely to meet desired conditions.

Riparian Vegetation

Natural recovery of conifer forest will occur slowly in the Riparian Reserve. The natural recovery along with the conifer reforestation effects will lead to the establishment of a conifer forest in about 20 years. The vegetation will be mosaic due to natural regeneration of grasses, shrubs and scattered conifers along with the mosaic planting of the conifer reforestation efforts which will include grasses and brush. The cumulative effect is that the Riparian Reserve will be on a trajectory toward the desired vegetative condition.

Connectivity

Connectivity will be improved by the recruitment of coarse woody debris and smaller woody material that will create pools and sediment traps in First Creek from both the decay of fire killed trees left behind and the re-established forest. The canopy will begin to close creating connectivity for terrestrial and semi-aquatic species in the next 20 years.

Peak Flow

The future foreseeable actions will affect peak flows and will contribute sediment to water bodies in Upper First Creek, Lower First Creek, Grass Lake Northeast, and Grass Lake South (Table 8 in appendix B). There are about 85, 8, 36, and 5 acres of ERA in the Upper First Creek, Lower First Creek, Grass Lake Northeast, and Grass Lake South respectively as a result of the future foreseeable actions. alternative 2 adds between 3 and 42 equivalent roaded acres (Table 5). The cumulative risk ratios are increased by less than 0.2 for the watersheds over the Affected Environment (Table 7 in appendix B). All the watersheds stay under the threshold of concern of a risk ratio of 1.0. When added together the cumulative effect of alternative 2 and the Affected Environment the peak flows will be increased by between 12% -13% (Table 4) for the next 10 years.

Table 6: Cumulative Percent ERA, Percent Equivalent Clearcut area and expected increase in peak flow using Grant et at (2008) for No Action.

Peak Flow (grant et al)	ERA (% of watershed)	Equivalent Clearcut Area (% of watershed)	Post-fire Increase in Peak Flow (%)
Upper First Creek	7.0%	28.0%	12%
Penoyar	8.6%	34.4%	12%
Lower First Creek	9.3%	37.2%	13%
Horsethief Creek	10.4%	41.6%	12%
Grass Lake Northeast	10.6%	42.4%	13%
Grass Lake South	6.9%	27.6%	12%

Cumulatively the channel geomorphology will remain intact and there will be an increase in the speed of conifer forest in the Riparian Reserve. The existing infrastructure can accommodate the

increase in peak flows expected. alternative 2 is likely to meet the desired condition for Riparian Reserves.

Risk to Water Quality

The cumulative effect to water quality is analyzed at the 7th field watershed scale. The cumulative risk ratio for the USLE model is increased by less than 0.02 over existing conditions. The future foreseeable actions do not add much to the sediment delivery in the 7th field when compared to the effects from the fire. Cumulatively, Upper and Lower First Creek 7th field watersheds are over the threshold of concern and there will be a nuisance impact to beneficial uses including sediment impacting agriculture infrastructure and turbidity in water used by semi-aquatic and terrestrial animals. These impacts are a short-term nuisance effect to the sediment regime at the watershed scale. The cumulative risk to beneficial uses from alternative 2 is moderate.

Alternative 3

There will be no dead tree removal, heavy equipment use or planting in the Riparian Reserves for alternative 3.

Direct and Indirect Effects

Function of Riparian Reserve

The direct and indirect effects of alternative 3 on *channel geomorphology, riparian vegetation and connectivity* are the same as for the No Action Alterative. The effects to peak flow are the same as for alternative 2.

Risk to beneficial uses

The effect of alternative 3 on sediment delivery to streams is similar to alternative 2. The difference is the sediment delivery estimated by the USLE model is 0.01 cubic yard less than for Upper and Lower First Creek (Table 8). The overall effect to beneficial uses is the same as for alternative 2.

Cumulative Effects

The cumulative effects for channel geomorphology, riparian vegetation, and connectivity are the same as for the No Action alternative. The cumulative effects on peak flow and water quality are the same as for alternative 2.

Compliance with law, regulation, policy, and the Forest Plan

The project complies with the Waiver conditions, which means that it complies with the Basin Plan, The Porter Cologne Act, the Total Maximum Daily Load and the Clean Water Act. The project also complies with the Forest Plan Standards and Guidelines (see Forest Plan Checklist in Project File).

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Appendix A– Maps

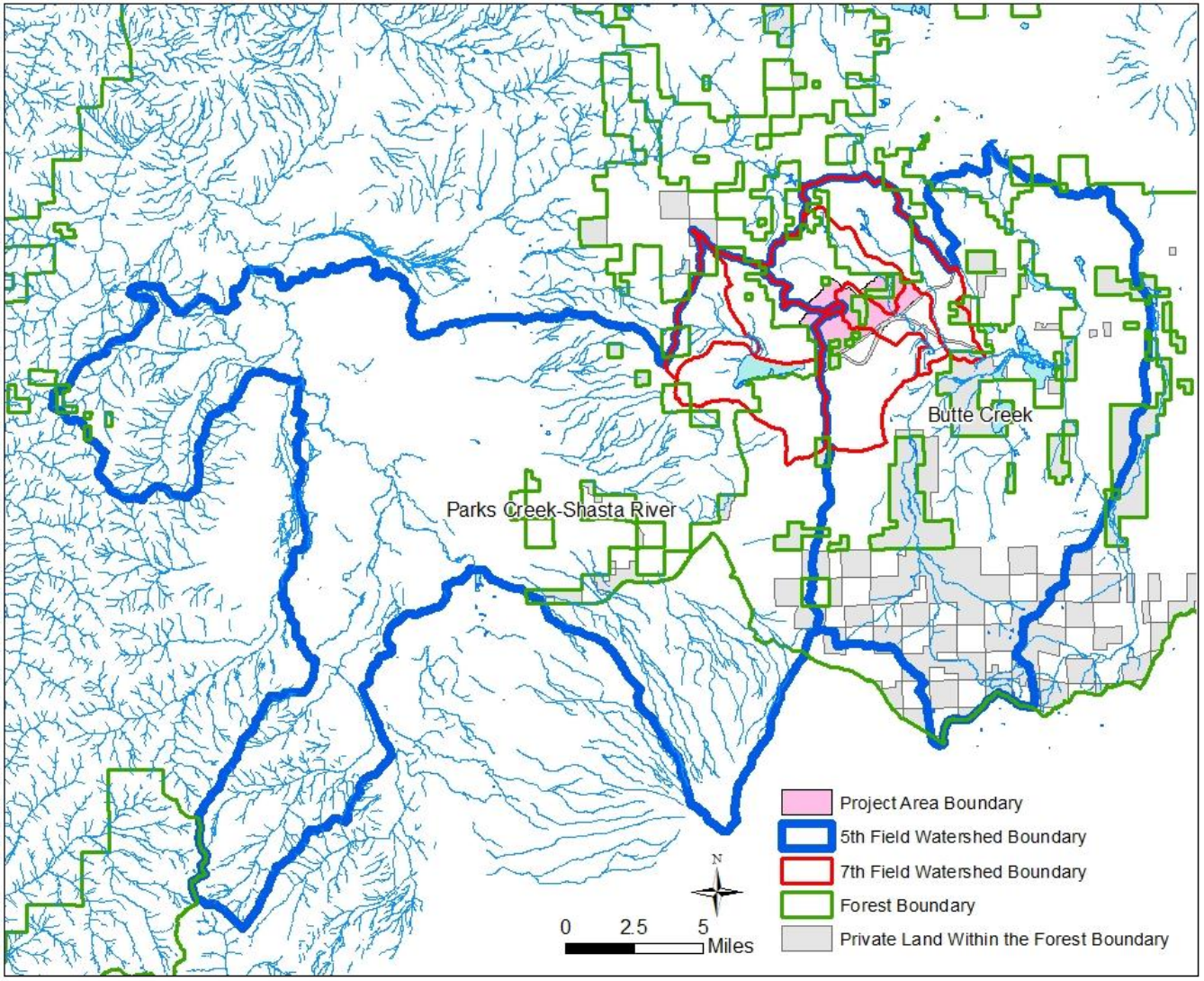

Figure 4: Project boundary in relation to 5th field watersheds Parks Creek-Shasta River(1801020704)and Butte Creek (1801020501).

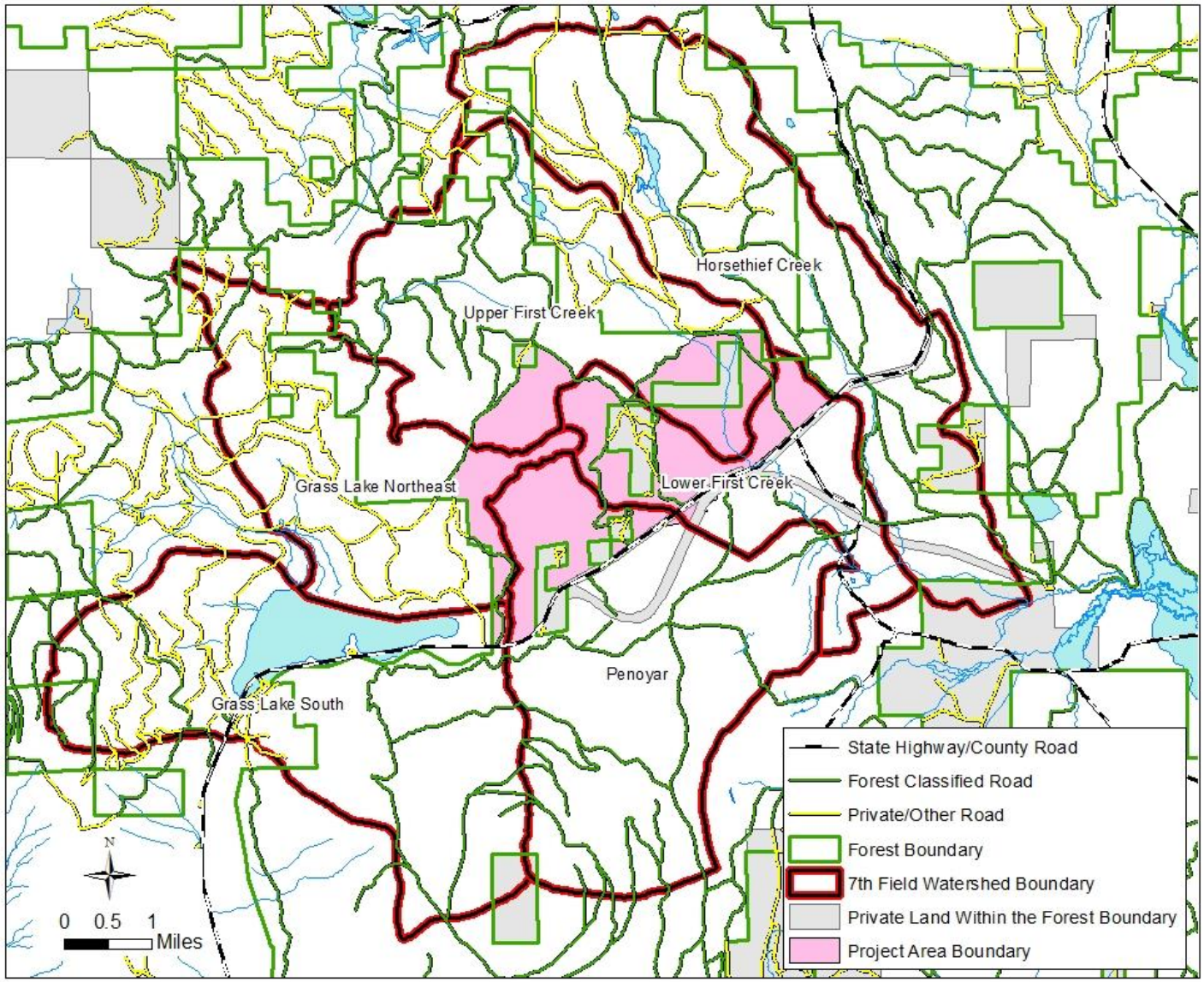

Figure 5: 7th field watersheds (drainages) that contain the project area.

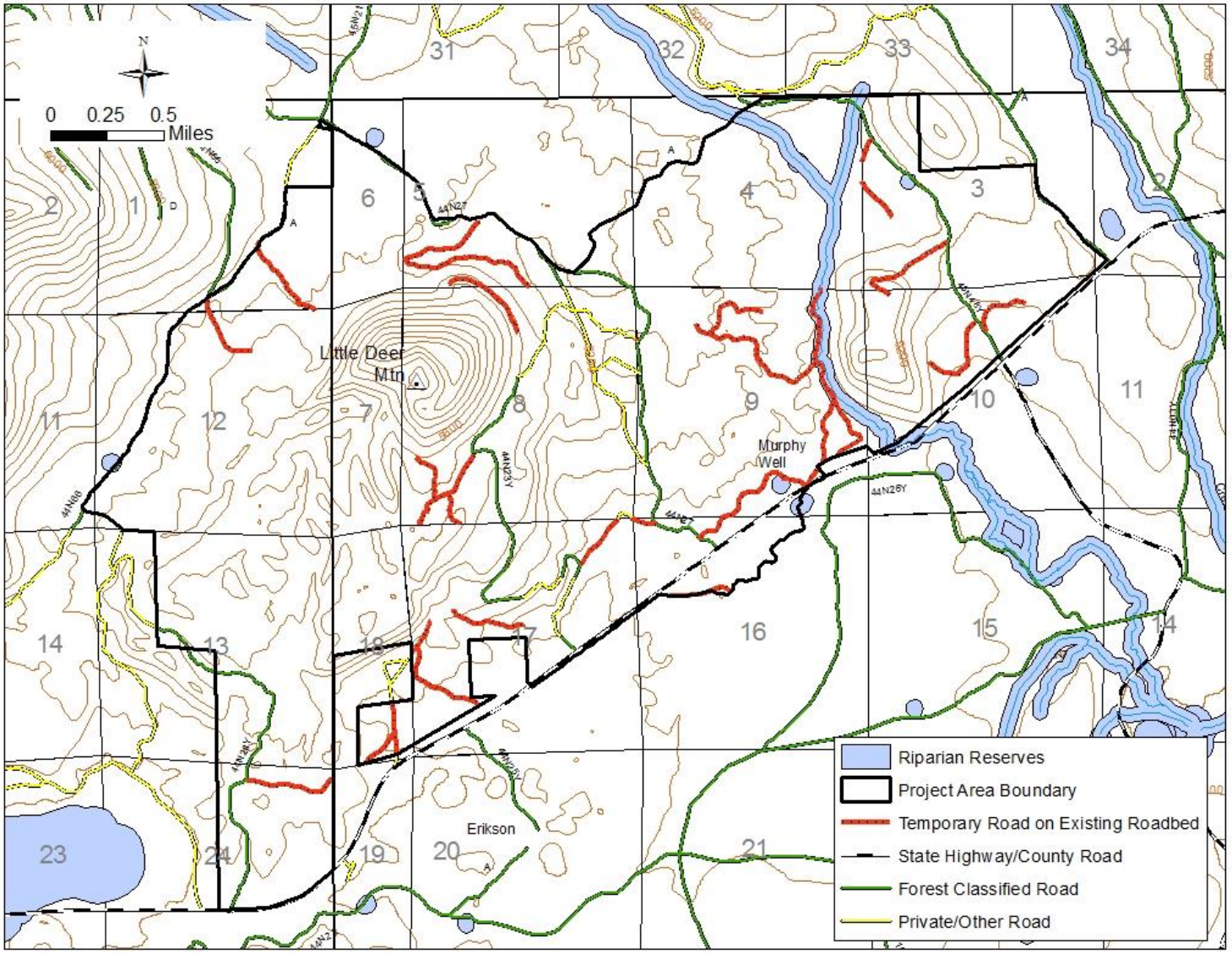

Figure 6: Riparian Reserves relative to the project boundary.

Appendix B– cumulative watershed effects Model Results

Table 7: Equivalent Roaded Area cumulative watershed effects model results for 7th field watersheds in project area.

7th Field Watershed Number	7th Field Watershed Name	Watershed Area (acres)	TOC for watershed (%)	ERA from Past harvest (acres)	ERA from Little Deer Fire (acres)	Current ERA from Roads (acres)	Affected Environment ERA Total (acres)	Affected Environment risk ratio	ERA from Future Actions (acres)	Cumulative risk ratio for No Action	Alt. 2 ERA (acres)	Alt. 2 Cumulative risk ratio	Alt. 3 ERA (acres)	Alt. 3 Cumulative risk ratio
18010205010301	Upper First Creek	6965.0	12.0%	121.3	171.4	77.9	370.6	0.44	85.0	0.55	32.2	0.58	29.1	0.58
18010205010302	Penoyar	7946.0	11.5%	361.4	142.7	105.1	609.3	0.67	0.0	0.67	36.3	0.71	31.5	0.70
18010205010303	Lower First Creek	3593.0	11.0%	23.4	196.7	65.6	285.7	0.72	8.4	0.74	41.6	0.85	34.8	0.83
18010205010304	Horsethief Creek	8677.0	12.0%	758.1	35.2	104.5	897.8	0.86	0.0	0.86	2.7	0.86	2.7	0.86
18010207040102	Grass Lake Northeast	5500.0	13.0%	403.5	71.5	64.5	539.5	0.75	35.7	0.80	9.5	0.82	9.5	0.82
18010207040103	Grass Lake South	8305.0	13.0%	439.5	8.5	118.6	566.6	0.52	4.9	0.53	4.8	0.53	4.8	0.53

Table 8: Universal Soil Loss Equation cumulative watershed effects model results for 7th field watersheds in project area.

7th Field Watershed Number	7th Field Watershed Name	Background Soil Loss (yd^3/year)	Soil Loss from Past Harvest (yd^3/year)	Soil Loss from Little Deer Fire (yd^3/year)	Soil Loss From Roads (yd^3/year)	Total Soil Loss (yd^3/year)	Affected Environment risk ratio	Soil Loss from Future Actions (yd^3/year)	Cumulative risk ratio for No Action	Alt. 2 Soil Loss (yd^3/year)	Alt. 2 Cumulative risk ratio	Alt. 3 Soil Loss (yd^3/year)	Alt. 3 Cumulative
18010205010301	Upper First Creek	23.8	0.0	48.7	35.1	107.5	1.13	1.1	1.14	0.31	1.15	0.30	1.14
18010205010302	Penoyar	30.7	0.8	24.8	55.8	112.0	0.91	0.0	0.91	0.27	0.92	0.27	0.92
18010205010303	Lower First Creek	14.1	0.0	50.2	30.5	94.8	1.68	0.8	1.70	0.44	1.71	0.43	1.71
18010205010304	Horsethief Creek	32.5	0.0	2.1	39.7	74.3	0.57	0.0	0.57	0.10	0.57	0.10	0.57
18010207040102	Grass Lake Northeast	22.1	0.0	13.2	46.7	82.0	0.93	1.4	0.94	0.10	0.94	0.10	0.94
18010207040103	Grass Lake South	36.7	0.0	1.1	74.3	112.1	0.76	0.8	0.77	0.03	0.77	0.03	0.77

Appendix C– Best Management Practices

Best Management Practices (BMPs) have been certified by the State Water Quality Resources Control Board and approved by the Environmental Protection Agency (EPA) as a way of protecting water quality from impacts stemming from non-point sources of pollution. These practices have been applied to forest activities and have been found to be effective in protecting water quality within the Klamath National Forest. Specifically, effective application of the R-5 USDA Forest Service BMPs has been found to maintain water quality that is in conformance with the Water Quality Objectives in the North Coast Region Water Quality Control Board's Basin Plan.

The following list of BMPs will be implemented in the Little Deer Project. A description of the objective of each BMP is included, as well as how each practice will be specifically implemented within the project. These are the "on-the-ground" prescriptions that are required by the Waiver. For additional information on the BMPs and their objectives, see Water Quality Management for Forest System Lands in California (USDA 2000) and R-5 Water Quality Management Handbook (USDA 2011).

BMP 1.3 - Determining Surface Erosion Hazard for Timber Harvest Unit Design - To identify high-erosion hazard areas to adjust treatment measures and prevent downstream water-quality degradation.

- The soil erosion hazard rating is analyzed in the Soil Resources report.

BMP 1.4 - Using Sale Area Maps and/or Project Maps for Designating Water-Quality Protection Needs - To ensure recognition and protection of areas related to water-quality protection delineated on a sale-area map or a project map.

- HYDR-3: Protected equipment exclusion areas and drafting sites will be on the Sale Area Map Temporary roads, riparian reserves, and landing locations will be displayed on Green Cards.

BMP 1.5 - Limiting the Operating Period of Timber Sale Activities - To ensure that the purchasers conduct their operations, including, erosion-control work, road maintenance, and so forth, in a timely manner, within the time specified in the timber sale contract.

- SOIL-8: The Klamath Wet Weather Operation Standards (WWOS) (USDA Forest Service 2002) will be used for all project activities.
- SOIL-9: The project is proposed to take place during the normal operating season (NOS) that is defined as May 1 to November 1and in dry periods outside the NOS with Line Officer approval. Actions will be restricted during periods of wet weather during the NOS.

BMP 1.8 - Streamside Management Zone Designation - To designate a zone along riparian areas, streams, and wetlands that will minimize potential for adverse effects from adjacent

management activities. Management activities within these zones are designed to improve riparian values.

- HYDR-1: RRs in the Project Area include intermittent streams and constructed ponds with 150 ft. widths.
- HYDR-8: In order to maintain potential coarse woody debris in the Riparian Reserves, non-hazard fire killed trees greater than 20 inches will not be removed from the Riparian Reserve adjacent to first creek in the Dead Tree Removal units.

BMP 1.9 - Determining Tractor-loggable Ground - To minimize erosion and sedimentation resulting from ground disturbance of tractor logging systems.

- See BMP 5.2.

BMP 1.10 - Tractor Skidding Design -: By designing skidding patterns to best fit the terrain, the volume, velocity, concentration, and direction of runoff water can be controlled in a manner that will minimize erosion and sedimentation.

- SOIL-3: No new full bench skid trails will be created.
- SOIL-7: Reuse existing skid trails and landings whenever practical. Dedicate no more than 15 percent of a unit to primary skid trails and landings by good yarding layout and administration.
- HYDR-9: Intermittent channels may be crossed at locations designated by the Forest Service when dry and stream banks unsaturated during skidding. Crossings will be in locations where the banks are gentle and not undercut.

BMP 1.12 - Log Landing Location - To locate new landings or reuse old landings in such a way as to avoid watershed impacts and associated water-quality degradation.

- HYDR-4: New landings will not be constructed within Riparian Reserves.

BMP 1.13 - Erosion Prevention and Control Measures during Timber Sale Operations - To ensure that the purchasers' operations will be conducted reasonably to minimize soil erosion.

- SOIL-4: If available on site, post-treatment soil cover will range from 60-80 percent depending on slope steepness and soil texture. If post-harvest soil cover is below recommended levels, slash will be left on site to prevent soil erosion.
- SOIL-5: Prevent road runoff from draining onto skid trails and or landings.
- SOIL-10: Tractor skidding will occur on designated skid trails. Tractors may leave skid trails to access isolated logs if ground conditions permit.
- SOIL-11: Waterbar skid trails per Sale Administration Handbook guidelines and as needed. Tree tops may be used instead of waterbars on slopes less than 10%.

BMP 1.19 - Streamcourse and Aquatic Protection - To conduct management actions within these areas in a manner that maintains or improves riparian and aquatic values; To provide

unobstructed passage of stormflows; To control sediment and other pollutants entering streamcourses; and To restore the natural course of any stream as soon as practicable, where diversion of the stream has resulted from timber management activities.

- HYDR-6: Spill kits will be on site during equipment fueling and lubrication
- SOIL-6: Retain existing coarse woody debris (CWD) whenever possible providing the amount of logs to meet fuel management objectives.

BMP 1.20 - Erosion-control Structure Maintenance - To ensure that constructed erosion-control structures are stabilized and working.

- HYDR-2: Erosion Control Measures will be maintained for up to 1 year post-installation.

BMP 2.4 - Road Maintenance and Operations - To ensure water-quality protection by providing adequate and appropriate maintenance and by controlling road use and operations.

- SOIL-1: Access to skid trails that intersect Forest Roads would be blocked with available material (either large wood or boulders) post-implementation.

BMP 2.5 - Water Source Development and Utilization - To supply water for road construction, maintenance, dust abatement, fire protection, and other management activities, while protecting and maintaining water quality.

- HYDR-5: Rocking of approaches in drafting sites will be used as required. All boards and plastic will be removed after use. Erosion control will be used at all locations where the possibility of water spill or overflow will result in sediment being moved toward the creek.
- HYDR-7: Pumps used for drafting will incorporate a mesh screened intake, openings not to exceed 3/16th inch. Portable pumps will be placed on an oil-absorbing mat. During water drafting, operations, stream flows will not be reduced by more than 10 percent at any time.

BMP 2.13 - Erosion Control Plan - Effectively limit and mitigate erosion and sedimentation from any ground-disturbing activities, through planning prior to commencement of project activity, and through project management and administration during project implementation.

- An Erosion Control Plan will be developed and incorporated in to the Waiver application and any timber sale contracts as appropriate.

BMP 5.2 - Slope Limitations for Mechanical Equipment Operation - To reduce gully and sheet erosion and associated sediment production by limiting tractor use.

- SOIL-2: Ground-based logging equipment will be restricted to slopes less than35 percent.

BMP 5.6 - Soil Moisture Limitations for Mechanical Equipment Operations - To prevent compaction, rutting, and gullying, with resultant sediment production and turbidity.

- See BMP 1.5

Refernces:

USDA Forest Service. (2002). *Klamath National Foest Wet Weather Operating Standards.* Yreka, CA: Klamath National Forest.

USFS, 2011. Forest Service Handbook Southwest Region (Region 5). Chapter 10-Water Quality Management Handbook Pacific Southwest Region, Vallejo, California.

USFS, 2000. Water quality management for National Forest system lands in California – Best Management Practices. Pacific Southwest Region, Vallejo, California.

Appendix D – Waiver if Waste Discharge Requirements Conditions

Project Description

Activities in Riparian Reserves (RR)

Description of Compliance with Waiver Terms for alternative 2

Condition 1) An Interdisciplinary Team (IDT) has completed their evaluation of the project. The multi-disciplinary resource team included earth scientists, as well as specialists in silviculture, botany, archaeology, wildlife, scenery, air quality, and fuels. The project includes on-the-ground prescriptions (Project Design Features) that are needed to implement the Best Management Practices (BMP) Manual (See appendix C).

alternative 2 includes dead tree removal in about 17 acres of Riparian Reserves along First Creek. Heavy equipment is not permitted within 30 feet of the bank of First Creek, Murphys Well and the construct stock pond, but will be used in the outer 120 feet of the Riparian Reserves (See project design features in chapter 2 of the EA). Non-hazard fire-killed trees greater than 20 inches in the Riparian Reserve adjacent to First Creek will be retained as snags and future coarse woody debris. There will be 60 acres of conifer reforestation in Riparian Reserves in alternative 2.

Condition 3) The BMPs, associated on-the-ground prescriptions, as well as wet weather operating standards are incorporated into the proposed action of the Jess Project (see Proposed Action in EA). These will be included in and enforced by the contract provision and a copy of the Waiver will be provided to the contractor. Contractors are subject to comply with all contract specifications and will be monitored on-site by the USFS.

Condition 4) There are two CWE model used to analyze this project: surface erosion and sediment delivery (Universal Soil Loss Equation, or USLE) and overall disturbance as measured by "equivalent roaded acres" (ERA). The USLE Model is an index of predicted sediment delivery for the first year following project completion. The ERA Model provides an accounting system for tracking disturbances that affect watershed processes. This report discusses the results of modeling the effects of project activities on these three elements. The mass-wasting model was not used in the analysis because the assumptions made in the model were not appropriate for the Little Deer project area and the probability of mass wasting in the area is very low (<10%).

All of the watersheds in the project area remain under threshold for ERA model. Upper and Lower First Creek are over the threshold of concern for USLE due to the effects of the Little Deer Fire. Due to recovery the area is expected to be below threshold for soil erosion in about 4 years.

Condition 5) A watershed restoration plan has not been prepared for the Little Deer project area. The watershed specialists on the IDT reviewed the treatment areas for potential, non-road related, sediment sources through field review, analyzing existing spatial data and air photo analysis.

One legacy site was found on a crossing in First Creek. There was a need for a dip and rock at the crossing. The Burned Area Emergency Response repair plan includes this site for mitigation. The work is expected to be completed by mid-November 2014. There are no other legacy sites in the project area.

Condition 6) The Proposed Action includes on-the-ground prescriptions, defined as Project Design Features in the NEPA documents, provided by the watershed specialists specifically to reduce the water quality impacts. The inclusions of the on-the-ground prescriptions as part of the proposed action ensures that they will be implemented via contract clauses (where appropriate) and on-site monitoring for compliance with contract provisions (see Condition 3).

Condition 7) On-site monitoring of on-the-ground prescriptions, via checklists and other tools, by the project inspector to ensure that all BMPs are being met during implementation. Site conditions will be re-evaluated to ensure BMPs are being met. Additionally, the Klamath National Forest Sediment and Temperature Monitoring Plan and Quality Assurance Plan further address the monitoring needs of the waver. The completed Checklist will be submitted with the Notice of Completion.

Condition 8) The Project is proposed to take place during the Normal Operating Season (NOS) that is defined as May 1 to November 1 and in dry periods outside the NOS with Line Officer approval. Activities will be restricted during periods of wet weather during the NOS. When there is a 30% chance of rain in the next 24 hours, the TSA will be on site to insure that winterization or erosion control procedures are implemented in a timely fashion and to initiate shutdown or resume operations. Operations will not resume until suitable weather, soil, and forecast conditions exist.

Conditions 9) The project does not propose any grazing.

Condition 10) There are on-the-ground prescriptions in the EA report that minimize sediment discharges into streams, including buffers along perennial/ephemeral streams and burn pile placement (See Activities in Riparian Reserves above).

Condition 14) Complying with Waver requirements, USFS shall manage and maintain designated riparian zones to ensure retention of adequate vegetative cover that results in natural shade conditions. The project design features were tailored on the basis of stream type (perennial, intermittent) and slope steepness.

Sediment discharge using Soil Erosion Hazard Rating, Soil Compaction Risk Rating, and Forest Soil Disturbance Rating are addressed in the Soils Specialist report. ERA and USLE summarized in the Water Quality report and chapter 3 of the EA. All specialists' reports designate BMPs and on-the-ground prescription.

In 2012, BMPs were fully implemented at 92% of the sites evaluated and fully effective at 87% of the sites evaluated. Five percent of the implementation evaluations fell into the "minor departure" category and three percent failed implementation. Eight percent of the effectiveness rating fell into the "at-risk" category and five percent failed effectiveness. Follow-up monitoring is also conducted for any sites that were not rated as fully effective

the previous year. This monitoring evaluates the success of corrective actions that were implemented the previous year. Improvements have been made in activities identified in 2011 as needing improvements, including grazing (G-24), road surface, drainage and slope protection (E-08), and skid trails (T-02). Further improvement in BMP effectiveness is needed for road surface and slope protection (E08), developed recreational sites, (R22), and in-channel construction (E13).

The majority of practices evaluated in 2012 were successful, due to management's commitment, training, and experience of project planners and implementers. This will be encouraged to continue the Forest's BMP successes. Suggestions made in the Adaptive Management discussion can improve BMP performance even further (see KNF 2012 BMP Evaluation Report).

Condition 15) The North Coast Water Quality Control Board was sent a project scoping letter on April 26, 2013. The letter outlined the location of the project and the proposed action.

Condition 16) The Little Deer project is not in a Key Watershed or a high risk watershed.

Condition 17) No new temporary roads will be created for this project.

Condition 18) A Notice of Completion will be sent to the Regional Water Board that states all conditions, monitoring and reporting was completed and conditions of the waver have been met.

Appendix E – Aquatic Conservation Strategy

The Forest Plan contains the components, objectives, and standards and guidelines for consistency of projects with the Aquatic Conservation Strategy. The Record of Decision (ROD) for the Forest Plan (USFS 1995) is the guiding document for Forest projects; it incorporates the Aquatic Conservation Strategy standards and guidelines from the ROD for Amendments to Forest Service and Bureau of Land Management Planning Documents within the Range of the Northern Spotted Owl (commonly known as the Northwest Forest Plan) (USDA Forest Service and USDI Bureau of Land Management 1994).

Current Conditions and Range of Variability
A full description of the Current Condition can be found in the Affected Environment Section of the Water Quality Report. Little Deer project area experienced a high severity wildfire in the summer of 2014. The nearly 5,500 acres burned in the Upper and Lower First Creek, Penoyar, Horsethief Creek, Grass Lake Northeast and Grass Lake South 7th field watersheds. As a result, there are components of watershed complexity and connectivity such as coarse woody material, cover, and large live trees that are scarce. The sediment delivery to streams is increased to over the threshold of concern which impacts water quality and the ability for the streams to support beneficial uses. Peak flows are increased for the next 10 years due to the loss of vegetation and soil cover. The riparian vegetation is mainly fire-killed. The grasses and shrubs are re-sprouting but the seed source for conifer recruitment is small.

The No Action alternative will allow for natural recovery of historical conditions but will require more than 50 year to do so. This affects the trends of recruitment of coarse woody debris, large conifer trees, native riparian vegetation and connectivity of the watershed in the Riparian Reserves (See Water Quality Report – Environmental Consequences: No Action).

The watershed historically would not have been highly complex. The Riparian Reserves would have had a few large trees per acre, mainly pine, and moderate amount of woody material. The sediment regime would have been low due to the low gradient and rock content of the soils in the area. Any fine material entering the stream would have been flushed to the vernal pool at the end of the channel each spring. The stream flow would have been and still is snow-melt driven with high flows in the spring and a dry channel for the rest of the year. This would have led to undercut, steep banks and a rocky stream bottom. The area is very rocky, with large piles of rock making up more than 10% of the area. Much of the area has shallow soils and will not support a conifer forest. Historically, the area was dominated by pine with a mix of brush and grasses in the openings (See Vegetation Report). The rock piles supported mahogany.

Details of the effects analysis can be found in the Water Quality Report and chapter 3 of the EA.

Alternative 2

1) **Maintain and restore the distribution, diversity, and complexity of watershed and landscape-scale features to ensure protection of the aquatic systems to which species, populations and communities are uniquely adapted.**

The analysis will consider effects to large wood recruitment to streams and large trees in the Riparian Reserve. On the short term, alternative 2 will not prevent the attainment of this objective at either the project level or the 5th field watershed scale. The project is designed to avoid the removal of any non-hazard fire-killed trees that meet the criteria for coarse woody debris in the Riparian Reserve. There are also patches of snags being left to meet wildlife and scenery requirements that account for about 10% of the dead tree removal units. On the long-term, the watershed complexity will be restored by alternative 2. The conifer reforestation efforts will decrease the amount of time it will take to get large trees in the Riparian Reserve compared to natural recovery alone. This will have a measurable effect on the project level, but a negligible effect on the 5th field watershed scale because of the small amount of any given 5th field being affected (about 3.5% of Butte Creek and 0.3% of Parks Creek-Shasta River).

2) Maintain and restore spatial and temporal connectivity between watersheds.

The analysis will consider effects to semi-aquatic and terrestrial species in the project area. On the short-term, the alternative will not prevent the attainment of the objective because of the snag retention in the project design. alternative 2 will lead to the restoration of watershed connectivity at the project scale. The conifer reforestation will decrease the time needed to re-establish a conifer forest in the Riparian Reserve. The re-establishment of a conifer forest will better facilitate the movement of semi-aquatic and terrestrial species move through the area by providing cover and areas to rest. This will have a measurable effect on the project level, but a negligible effect on the 5th field watershed scale because of the small amount of any given 5th field being affected (about 3.5% of Butte Creek and 0.3% of Parks Creek-Shasta River).

3) Maintain and restore the physical integrity of the aquatic system, including shorelines, banks, and bottom configurations.

The analysis will consider effects to channel geomorphology. On the short-term, the alternative will not prevent the attainment of the objective because of project design features limiting heavy equipment use in the Riparian Reserves and the retention of non-hazard, fire-killed trees greater than 20 inches dbh in the Riparian Reserve. alternative 2 will restore aquatic systems integrity on the long-term at the project scale. Conifer reforestation will reduce the amount of time the bank stability is susceptible to high flows by establishing a conifer forest faster than natural recovery alone. The effect at the 5th field scale is negligible because of the small amount of any given 5th field being affected (about 3.5% of Butte Creek and 0.3% of Parks Creek-Shasta River).

4 & 5) Maintain and restore water quality necessary to support healthy riparian, aquatic, and wetland ecosystems; and Maintain and restore the sediment regime under

which aquatic ecosystems evolved. Elements of the regime include the timing, volume, rate, and character of sediment input, storage, and transport.

Changes to water quality and sediment regime will be analyzed using the USLE model. The alternative will not prevent the attainment of this objective on the short or long-term scale on either the project level or the 5th field level. The Little Deer fire elevated the sediment delivery in the watersheds (Table 8 in appendix B of the Water Quality Report). Even when added to the estimated sediment delivery from the dead tree removal and associate activities (landings and temporary roads on existing roadbeds) beneficial uses are continued to be supported at the project scale. The effect at the 5th field scale is negligible because of the small amount of any given 5th field being affected (about 3.5% of Butte Creek and 0.3% of Parks Creek-Shasta River).

6 & 7) Maintain and restore in-stream flows sufficient to create and sustain riparian, aquatic, and wetland habitats, and to retain patterns of sediment, nutrient, and wood routing. The timing, magnitude, duration, and spatial distribution of peak, high, and low flows must be protected; and Maintain and restore the timing, variability, and duration of floodplain inundation and water table elevation in meadows.

The water quantity analysis considers the effect to base flow using a qualitative assessment and peak flow using the Equivalent Roaded Acres model. The alternative will not prevent the attainment of this objective on the short or long-term on either the project level or 5th field level. The Little Deer fire elevated the peak flow (See Water Quality report – Affected Environment). Even when adding the dead tree removal and associated activities (landings and temporary roads on existing roadbeds) the peak flow is increased by less than 14% over natural levels. This will remain elevated for about 10 years then will start to decrease. The 14% elevation is not likely to overlap temporally with the timeframe when the channel is most susceptible to high flows which is about 15 years from the year of the fire. The effect at the 5th field scale is negligible because of the small amount of any given 5th field being affected (about 3.5% of Butte Creek and 0.3% of Parks Creek-Shasta River).

8 & 9) Maintain and restore the species composition and structural diversity of plant communities in riparian areas; and Maintain and restore habitat to support well-distributed populations of native plant and invertebrate riparian dependent species.

This analysis will consider the expected effects to riparian vegetation. alternative 2 does not prevent the attainment of this objective on the short-term at either spatial scale analyzed. The trees being removed are fire-killed or have a 70% or greater probability of dying as a result of fire damage. On the long-term the alternative has a high likelihood of contributing to vegetation diversity at the project level. The conifer replanting will be in a mosaic pattern and will include ponderosa as well as shrubs and grasses. There are areas

of browse planting as well as mahogany being planted in the rocky areas. This is meant to mimic the historical pattern of vegetation on the landscape. Native grasses are being planted to combat the spread of invasive plant species into the fire disturbed landscape. The alternative will contribute to the restoration of biological and structural diversity at the project level. It also attempts to keep native species on the landscape and minimize invasion of non-native species on the long-term. The effect at the 5th field scale is negligible because of the small amount of any given 5th field being affected (about 3.5% of Butte Creek and 0.3% of Parks Creek-Shasta River).

Alternative 3

1) **Maintain and restore the distribution, diversity, and complexity of watershed and landscape-scale features to ensure protection of the aquatic systems to which species, populations and communities are uniquely adapted.**

   The analysis will consider effects to large wood recruitment to streams and large trees in the Riparian Reserve. The recruitment of large trees and coarse woody debris in the Riparian Reserve will be stunted because this alternative relies on natural recovery in the Riparian Reserves. It will take longer to recruit a conifer forest due to the lack of seed source left behind by the Little Deer Fire. The will be large amount of downed wood recruited over the next 5 to 10 years as the dead trees fall. Most of the dead trees do not meet the requirements for coarse woody debris so the drainage will remain deficient in this essential aspect of watershed complexity. alternative 3 does not actively work to maintain and restore watershed complexity, but it does not prevent the attainment of the objective. This will have no effect on the project level or the 5th field watershed scale because no action is being taken in the Riparian Reserve.

2) **Maintain and restore spatial and temporal connectivity between watersheds.**

   The analysis will consider effects to semi-aquatic and terrestrial species in the project area. The cover and coarse woody debris needed to provide connectivity within and between watersheds will be slow to recover for alternative 3. The alternative does nothing to activity recover conifer forest in the Riparian Reserves and relies only on natural recovery of trees. alternative 3 does not actively maintain and restore watershed connectivity, but it does not prevent the attainment of the objective. This will have no effect on the project level or the 5th field watershed scale because no action is being taken in the Riparian Reserve.

3) **Maintain and restore the physical integrity of the aquatic system, including shorelines, banks, and bottom configurations.**

The analysis will consider effects to channel geomorphology. There will be no heavy equipment in the Riparian Reserves and crossing the creek with heavy equipment is prohibited. There is no impact to channel geomorphology on the short-term. alternative 3 relies on natural recovery which will lead to a slow recovery of conifer forest in the Riparian Reserve. There will be a sharp increase in downed wood in the Riparian Reserve as the fire killed trees fall to the ground. These trees, however, are not large enough to meet the coarse woody debris requirements set in the Forest Plan. The downed wood will be beneficial to the physical integrity of the stream channel. There will be a gap in time where bank stability from root support will be limited. The tree roots of the fire killed trees will begin to decay about 10-15 years from now. There will not be a well-established conifer forest in the Riparian Reserve for more than 50 years without conifer reforestation efforts. So banks will be susceptible to high flows for about 35 years in alternative 3. This alternative does not actively maintain and restore the physical integrity of aquatic systems, but it does not prevent the attainment of the objective. This will have no effect on the project level or the 5th field watershed scale because no action is being taken in the Riparian Reserve.

4 & 5) Maintain and restore water quality necessary to support healthy riparian, aquatic, and wetland ecosystems; and Maintain and restore the sediment regime under which aquatic ecosystems evolved. Elements of the regime include the timing, volume, rate, and character of sediment input, storage, and transport.

Changes to water quality and sediment regime will be analyzed using the USLE model. The alternative will not prevent the attainment of this objective on the short or long-term scale on either the project level or the 5th field level. The Little Deer fire elevated the sediment delivery in the watersheds (Table 8 in appendix B of the Water Quality Report). Even when added to the estimated sediment delivery from the dead tree removal and associate activities (landings and temporary roads on existing roadbeds) beneficial uses are continued to be supported at the project scale. The effect at the 5th field scale is negligible because of the small amount of any given 5th field being affected (about 3.5% of Butte Creek and 0.3% of Parks Creek-Shasta River).

6 & 7) Maintain and restore in-stream flows sufficient to create and sustain riparian, aquatic, and wetland habitats, and to retain patterns of sediment, nutrient, and wood routing. The timing, magnitude, duration, and spatial distribution of peak, high, and low flows must be protected; and Maintain and restore the timing, variability, and duration of floodplain inundation and water table elevation in meadows.

The water quantity analysis considers the effect to base flow using a qualitative assessment and peak flow using the Equivalent Roaded Acres model. The alternative will not prevent the attainment of this objective on the short or long-term on either the project

level or 5th field level. The Little Deer fire elevated the peak flow (See Water Quality report – Affected Environment). Even when adding the dead tree removal and associated activities (landings and temporary roads on existing roadbeds) the peak flow is increased by less than 14% over natural levels. This will remain elevated for about 10 years then will start to decrease. The 14% elevation is not likely to overlap temporally with the timeframe when the channel is most susceptible to high flows which is about 15 years from the year of the fire. The effect at the 5th field scale is negligible because of the small amount of any given 5th field being affected (about 3.5% of Butte Creek and 0.3% of Parks Creek-Shasta River).

8 & 9) Maintain and restore the species composition and structural diversity of plant communities in riparian areas; and Maintain and restore habitat to support well-distributed populations of native plant and invertebrate riparian dependent species.

This analysis will consider the expected effects to riparian vegetation. alternative 3 relies on natural recovery of vegetation in the Riparian Reserve. There were already shrubs and grasses re-sprouting during field visits in October 2014. However, there is limited seed source for conifer regeneration due to the high severity fire effects. There will be a gap in time (~ 20 years) where there will be few conifers in the Riparian Reserves and it will take about 50 years for those trees to contribute to canopy cover and nutrient cycling to support invertebrate riparian dependent species. alternative 3 does not actively maintain and restore the structural diversity and native plant communities in the Riparian Reserve, but it does not prevent the attainment of the objective. This will have no effect on the project level or the 5th field watershed scale because no action is being taken in the Riparian Reserve.